

## CLAIMS

Having thus described the aforementioned invention, I claim:

1. An apparatus for containing and cooling enriched water for the production of fluorine-18, said apparatus comprising:

5 a target body for coupling to an accelerator;

a target chamber for holding a volume of enriched water within said target body, said target chamber having an upper wall defined by said target body; and

a first cooling channel spaced a selected distance from said upper wall for removing heat contained in said target chamber, said first cooling channel isolated  
10 from said target chamber, said cooling channel for receiving a cooling fluid.

2. The apparatus of Claim 1 further including a second cooling channel spaced a selected distance from a back wall of said target chamber for removing heat contained in said target chamber, said second cooling channel in fluid communication with said first cooling channel.

15 3. The apparatus of Claim 2 wherein said cooling fluid flows from said second cooling channel into said first cooling channel.

4. The apparatus of Claim 1 further including a third cooling channel parallel to said first cooling channel, said third cooling channel spaced a selected distance from said upper wall.

20 5. The apparatus of Claim 1 further including a second cooling channel spaced a selected distance from a back wall of said target chamber for removing heat contained in said target chamber; a third cooling channel substantially parallel to said first cooling channel, said third cooling channel spaced a selected distance from said upper wall for removing heat contained in said target chamber;

and a fourth cooling channel substantially parallel to said second cooling channel, said fourth cooling channel spaced a selected distance from said back wall for removing heat contained in said target chamber.

5        6.        The apparatus of Claim 1 wherein said target body is fabricated out of tantalum.

7.        The apparatus of Claim 1 wherein a coolant flowing through said first cooling channel has at least a nearly fully developed flow.

8.        The apparatus of Claim 1 wherein a coolant flowing through said first cooling channel has a Reynolds number indicating a turbulent flow.

10        9.        The apparatus of Claim 1 wherein said back wall is canted such that said back wall proximal said upper wall is further away from a front surface of said target body than a distal end of said back wall.

15        10.       The apparatus of Claim 1 wherein said target chamber is shaped such that a quantity of enriched water in said target chamber undergoes natural circulation when bombarded with a particle beam.

11.       The apparatus of Claim 1 wherein said target chamber includes means for inducing fluid flow in the enriched water.

12.       The apparatus of Claim 1 wherein said upper wall of said target chamber has an arcuate cross-section, as viewed from a front vantage point.

13. An apparatus for containing and cooling enriched water for the production of fluorine-18, said apparatus comprising:

a target body for coupling to an accelerator;

a target chamber for holding a volume of enriched water within said target  
5 body, said target chamber defined by an upper wall and a back wall; and

a first cooling channel spaced a selected distance from said upper wall for removing heat contained in said target chamber, said first cooling channel isolated from said target chamber; and

a second cooling channel spaced a selected distance from said back wall for  
10 removing heat contained in said target chamber, said second cooling channel isolated from said target chamber, said second cooling channel in fluid communication with said first cooling channel.

14. The apparatus of Claim 13 further including a third cooling channel substantially parallel to said first cooling channel, said third cooling channel  
15 spaced a selected distance from said back wall for removing heat contained in said target chamber, and a fourth cooling channel substantially parallel to said second cooling channel, said fourth cooling channel spaced a selected distance from said back wall for removing heat contained in said target chamber.

15. The apparatus of Claim 13 wherein a coolant flows from said second  
20 cooling channel into said first cooling channel.

16. The apparatus of Claim 13 wherein said target body is fabricated out of tantalum.

17. The apparatus of Claim 13 wherein said back wall is canted such that said back wall proximal said upper wall is further away from a front surface of said target body than a distal end of said back wall.

18. The apparatus of Claim 13 wherein said target chamber includes  
5 means for inducing fluid flow in the enriched water.

19. The apparatus of Claim 13 wherein said target chamber is shaped such that a quantity of enriched water in said target chamber undergoes natural circulation when bombarded with a particle beam.

20. The apparatus of Claim 13 wherein said target chamber is shaped  
10 such that a steam jet is formed adjacent a beam strike area adjacent a window covering said target chamber, said target chamber further shaped wherein said steam jet flows to a steam bubble adjacent said upper wall in said target chamber, and said first cooling channel transferring heat from said steam bubble whereby condensing occurs in said steam bubble.

21. The apparatus of Claim 13 wherein said target body is fabricated out  
15 of tantalum.

22. The apparatus of Claim 13 wherein a coolant flowing through said first cooling channel has a developed flow.

23. The apparatus of Claim 13 wherein a coolant flowing through said  
20 second cooling channel has a fully developed flow.

24. The apparatus of Claim 13 wherein a coolant flowing through said first and second cooling channels have a developed flow.

25. The apparatus of Claim 13 wherein a coolant flowing through said first cooling channel has a Reynolds number indicating a turbulent flow.

26. The apparatus of Claim 13 wherein a coolant flowing through said second cooling channel has a Reynolds number indicating a turbulent flow.

5 27. The apparatus of Claim 13 wherein a coolant flowing through said first and second cooling channels have a Reynolds number indicating a turbulent flow.

28. The apparatus of Claim 13 wherein said upper wall of said target chamber has an arcuate cross-section, as viewed from a front vantage point.

10 29. An apparatus for containing and cooling enriched water for the production of fluorine-18, said apparatus comprising:

a target body for coupling to an accelerator, said target body fabricated of tantalum;

15 a target chamber for holding a volume of enriched water within said target body, said target chamber defined by an upper wall and a back wall, said back wall canted such that said back wall proximal said upper wall is further away from a front surface of said target body than a distal end of said back wall; and

20 a first cooling channel spaced a selected distance from said upper wall for removing heat contained in said target chamber, said first cooling channel isolated from said target chamber, said first cooling channel sized such that said first cooling channel sustains a developed flow; and

a second cooling channel spaced a selected distance from said back wall for removing heat contained in said target chamber, said second cooling channel isolated from said target chamber, said second cooling channel sized such that

said second cooling channel sustains a developed flow, said second cooling channel in fluid communication with said first cooling channel.

30. The apparatus of Claim 29 further including a third cooling channel substantially parallel to said first cooling channel, said third cooling channel  
5 spaced a selected distance from said back wall but isolated from said target chamber, and a fourth cooling channel substantially parallel to said second cooling channel, said fourth cooling channel spaced a selected distance from said back wall but isolated from said target chamber.

31. The apparatus of Claim 29 wherein said upper wall of said target  
10 chamber has an arcuate cross-section, as viewed from a front vantage point.

32. An apparatus for containing and cooling enriched water for the production of fluorine-18, said apparatus comprising:

a means for containing a target liquid for irradiation; and

a means for cooling said apparatus.

15 33. The apparatus of Claim 32 wherein said means for cooling includes internal water channels through which a cooling water has developed flow.

34. The apparatus of Claim 32 wherein a coolant flowing through said first cooling channel has a Reynolds number indicating a turbulent flow.